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| --- |
| Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Class \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| **Forces in 1-Dimension Simulation** |



**Introduction:**

Newton’s Laws describe motion and forces in the world around us. Object have inertia, undergo acceleration and experience forces. Forces are measured in Newtons (N)…

Newton’s First Law states: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Newton’s Second Law states: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Newton’s Third Law states: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

When objects slide past each other in contact, ***friction*** usually plays a part. There are two types of friction; ***Static***, which exists between objects BEFORE the objects start moving and ***kinetic*** which exists between objects that ARE MOVING.

**Remember…it is not the presence of forces that cause acceleration…it is the presence of unbalanced or NET forces!**

**Procedure:** *Play with the Sims 🡪 Motion 🡪 Forces in 1 Dimension* 

1.  the simulation between runs to reset the simulation.
2. **Slowly** drag the cabinet to the right to apply a force (blue vector). Observe the *applied force* and *friction force*.
3. Without movement, the applied force and friction forces are \_\_\_\_\_\_\_\_\_\_\_\_\_.
4. Once the cabinet starts to move, keep your mouse immobile to apply the same, constant force.

What happened? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Click Clear, and then epeat steps 1-3, but release the mouse button once the cabinet starts to move. Without applied force, the force of friction does what? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Click Clear, and then repeat the above experiments after clicking on , , and  to show the A-V-D graphs of motion.

Draw a sketch of the acceleration, velocity, and distance graphs produced when the cabinet moves with a **constant acceleration.** *(acceleration is produced when Force applied > Force friction. This is a NET FORCE)*

ACCELERATION VS TIME VELOCITY VS TIME DISTANCE VS TIME

* Click the ***Friction*** box (RIGHT side of the simulation) to remove friction.
* Drag the cabinet to apply a force for a few seconds and then release the mouse and allow the cabinet to move freely.
* Without friction, all the force applied creates acceleration.
* Without an applied force (while coasting), the acceleration becomes\_\_\_\_\_\_\_\_\_\_ and velocity becomes \_\_\_\_\_\_\_\_.

**The Math of Newton’s Second Law**

Reset the simulation. *Keep friction turned off during the next set of experiments.*

Set the Force on the slider (on the left) to a value as shown in the boxes below. (Press “CLEAR”, type in value, press ENTER, then click GO”) Determine the acceleration from the acceleration-time graph.

|  |  |  |
| --- | --- | --- |
| **Force applied** | **Mass (cabinet)** | **acceleration** |
| 100. N | 200. kg |  |
| 200. N | 200. kg |  |
| 400. N | 200. kg |  |
| 600. N | 200. kg |  |
| **Force applied** | **Mass (cabinet)** | **acceleration** |
| 50. N | 200. kg |  |
| 20. N | 200. kg |  |
| 10. N | 200. kg |  |

Fill in the blanks in the table below using math FIRST, and then check your work with the simulations.

|  |  |  |
| --- | --- | --- |
| **Force applied** | **Mass (fridge)** | **acceleration** |
| 800. N | 400. kg | 1. |
| 50. N | 400. kg | 2. |
| 1000. N | 400. kg | 3. |
| **Force applied** | **Mass (dog)** | **acceleration** |
| 25. N | 25.0 kg | 4. |
| 5. | 25.0 kg | 2.0 m/s2 |
| 200. N | 25.0 kg | 6. |
| **Force applied** | **Mass (large book)** | **acceleration** |
| 5. N | 10.0 kg | 7. |
| 20. N | 10.0 kg | 8. |
| 9. | 10.0 kg | 4.0 m/s2 |
| **Force applied** | **Mass (crate)** | **acceleration** |
| 100. N | 300. kg | 10. |
| 300. N | 300. kg | 11. |
| 12. | 300. kg | 2.5 m/s2 |

**Conclusion Questions**

1. As a small force was applied to the cabinet, the cabinet didn’t move because the magnitude of the force of friction *was larger than / smaller than / equal to* the applied force. BE CAREFUL HERE
2. Our experiment showed that static (not moving) friction is *greater than / less than* kinetic (moving) friction.
3. I’m not accelerating, so the net (vertical) force on me, while I’m sitting here doing this lab is \_\_\_\_\_\_\_\_\_.
4. Without friction, applying a **constant force** produces a *decreasing / constant / increasing* **acceleration**.
5. Without friction, applying a **constant force** produces a *decreasing / constant / increasing* **speed**.
6. While coasting (no applied force) without friction, the acceleration is \_\_\_\_\_\_\_\_\_\_ and velocity is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
7. When a force of 300. N is applied to an object that experiences 200. N of friction the **net force** that will cause acceleration would be \_\_\_\_\_\_\_\_\_\_\_.
8. Imagine you push a 50. kg crate with 200. N of force. If friction pushes back with 100 N of force, the crate will accelerate with a magnitude of \_\_\_\_\_\_\_\_\_\_m/s2.